If you are using a printed copy of this procedure, and not the on-screen version, then you MUST make sure the dates at the bottom of the printed copy and the on-screen version match.
The on-screen version of the Collider-Accelerator Department Procedure is the Official Version.
Hard copies of all signed, official, C-A Operating Procedures are kept on file in the C-A ESHQ Training Office, Bldg. 911A.

C-A OPERATIONS PROCEDURES MANUAL

7.1.57 Regeneration of Warm Turbines "A" Train

Text Pages 2 through 10

Hand Processed Changes

HPC No.	Date	Page Nos.	Initials

Approved: _____***Signature on File***_____ _____
Collider-Accelerator Department Chairman Date

S. Sakry

7.1.57 Regeneration of Warm Turbines "A" Train

1. Purpose

To provide instructions for regenerating the warm turbine "A" train on the RHIC 25 kW helium refrigerator. The procedure is used to warm the turbines and remove moisture. The procedure contains the following sections:

5.1 Regeneration of Turbines 1A/2A Only.
5.2 Regeneration of Turbines 3A/4A Only.
5.3 Regeneration of HX3A Only.
5.4 Regeneration of Turbines 1A/2A, 3A/4A and Heat Exchanger HX3A.

2. Responsibilities

2.1 The Shift Supervisor, or an Operator designated by the Shift Supervisor, is responsible for conducting the procedure and providing documentation in the Cryogenic Control Room Log and in the Cryogenic Valve Log.

2.2 Should a problem arise in the process of the procedure, the Shift Supervisor shall report to the Technical Supervisor for instructions before continuing.

3. Prerequisites

3.1 The Operator shall be trained by the Shift Supervisor.

3.2 Operator shall be familiar with the refrigerator P&ID drawing 3A995009, the physical location of components on the refrigerator, and the refrigerator control pages found on the CRISP control system. Valves and equipment mentioned in this procedure will be found on drawing 3A995009.

3.3 The regeneration skid must be available for use.

4. Precautions

4.1 If there is liquid helium in the refrigerator pots, all personnel entering the refrigeration wing of 1005R must be ODH Class 1 qualified, have a Personal Oxygen Monitor (POM), and carry an emergency escape pack, if the refrigerator is operating.

5. Procedure

5.1 Turbines 1A/2A Only

_____ 5.1.1 Date_____.

_____ 5.1.2 Ensure mechanical brakes are installed per C-A-OPM 7.1.26, "Expander Brake System Installation and Removal."

_____ 5.1.3 Ensure the following valves are closed:

Process:

H328A____
H338M____

Other:

H407M____ H400M____
H703M____ H773M____
H9171M____

_____ 5.1.4 Start the regeneration (regen) skid per C-A OPM 7.1.36, "Regeneration System Normal Operation."

_____ 5.1.5 Ensure that the regulator PR9169M has been replaced with the spool piece.

_____ 5.1.6 Open the following valves:

H405M____ H243M____
H266M____ H330A____ (Vanes)
H9169M____ H339A____ (Vanes)
H373M____

_____ 5.1.7 Close regen manifold bypass valve H9100M.

_____ 5.1.8 If turbine train is cold, turn on regen skid pre-heater.

_____ 5.1.9 Monitor temperature at TI337H.

_____ 5.1.10 When TI337H reaches 290^{o}K, continue to regenerate for at least one hour. Hygrometer reading must be –20^{o}C to –40^{o}C and improving less than 0.5^{o}C/hour.

_____ 5.1.11 Turn off regen skid pre-heater.

_____ 5.1.12 Open bypass valve H9100M.

_____ 5.1.13 Close the following valves:

H330A____	H9169M____
H339A____	H266M____
H243M____	H405M____
H373M____	

_____ 5.1.14 Secure the regen skid per C-A OPM 7.1.36.

_____ 5.1.15 Install regulator PR9169M.

_____ 5.1.16 Purge expander 1A/2A per C-A OPM 7.1.27, "Warm Expander Purge Procedure."

5.2 Turbines 3A/4A Only

_____ 5.2.1 Date_____.

_____ 5.2.2 Ensure mechanical brakes are installed on turbines 3A/4A per C-A OPM 7.1.26, "Expander Brake System Installation and Removal."

_____ 5.2.3 Ensure the following valves are closed:

Process:

H352A____
H380A____
H360M____

Other:

H429M____	H9177M____
H777M____	H427M____
H6182M____	H778M____

_____ 5.2.4 Start the regeneration (regen) skid per C-A OPM 7.1.36, "Regeneration System Normal Operation."

_____ 5.2.5 Ensure that regulator PR9175M has been replaced with the spool piece.

_____ 5.2.6 Open the following valves:

H428M____	H415M____
H377M____	H354A____ (Vanes)
H9175M____	H357A____ (Vanes)
H378M____	

_____ 5.2.7 Close regen skid bypass valve H9100M.

_____ 5.2.8 If turbine train is cold, turn on regen skid pre-heater.

_____ 5.2.9 Monitor turbine 4A outlet temperature at TI361H.

_____ 5.2.10 When TI361H reaches 290^{o}K, continue to regenerate for at least one hour. Hygrometer reading must be –20^{o}C to –40^{o}C and improving less than 0.5^{o}C/hour.

_____ 5.2.11 Turn off regen skid pre-heater.

_____ 5.2.12 Open bypass valve H9100M.

_____ 5.2.13 Close the following valves:

H354A____	H9175M____
H357A____	H377M____
H415M____	H428M____
H378M____	

_____ 5.2.14 Secure the regen skid per C-A OPM 7.1.36, "Regeneration System Normal Operation."

_____ 5.2.15 Install regulator PR9175M.

_____ 5.2.16 Purge expanders 3A/4A per C-A OPM 7.1.27, "Warm Expander Purge Procedure."

5.3 Heat Exchanger HX3A Only

_____ 5.3.1 Date_____.

_____ 5.3.2 Ensure mechanical brakes are installed on turbines 1A/2A and 3A/4A per C-A OPM 7.1.26, "Expander Brake System Installation and Removal."

_____ 5.3.3 Ensure the following valves are closed:

Process:

H330A____ (Vane)	H376M____
H339A____ (Vane)	H346M____
H354A____ (Vane)	H426M____
H357A____ (Vane)	H380A____ (Physically Block)
H344A____	H328A____ (Physically Block)
H341M____	

Other:

H429M____	H9177M____
H6182M____	H400M____
H777M____	H773M____

_____ 5.3.4 Start the regeneration (regen) skid per C-A OPM 7.1.36, "Regeneration System Normal Operation."

_____ 5.3.5 Ensure that regulator PR9175M has been replaced with the spool piece.

_____ 5.3.6 To avoid spinning turbines, ensure pressure in HX3A is approximately equal to pressure in expanders (with 0.5 atm).

_____ 5.3.7 Open process valves H338M____ and H352A____ (air line must be jumpered at valve).

_____ 5.3.8 Open the following valves:

H428M____	H373M____
H377M____	H243M____
H9175M____	

_____ 5.3.9 Close regen skid bypass valve H9100M.

_____ 5.3.10 If heat exchanger is cold, turn on regen skid pre-heater.

_____ 5.3.11 Monitor regen return line at valve H373M.

_____ 5.3.12 When frost has cleared from the regen return line, continue to regen for at least one hour. Hygrometer reading must be $-20^{o}C$ to $-40^{o}C$ and improving less than $0.5^{o}C$/hour.

_____ 5.3.13 Turn off regen skid pre-heater.

_____ 5.3.14 Open bypass valve H9100M.

_____ 5.3.15 Close the following valves:

H243M____ H377M____
H373M____ H428M____
H9175M____

_____ 5.3.16 Install regulator PR9175M.

> **Note:**
> **If the refrigerator is operating, heat exchanger and turbines are normally purged separately due to heat transfer between HX3 heat exchangers.**

_____ 5.3.17 Purge heat exchanger HX3A per C-A OPM 7.1.27, "Warm Expander Purge Procedure."

_____ 5.3.18 Purge expanders 1A/2A per C-A OPM 7.1.27, "Warm Expander Purge Procedure."

_____ 5.3.19 Purge expanders 3A/4A per C-A OPM 7.1.27, "Warm Expander Purge Procedure."

_____ 5.3.20 Ensure the following process valves are closed:

H352A____ (Return air line to normal)
H338M____

_____ 5.3.21 Secure regen skid per C-A OPM 7.1.36, "Regeneration System Normal Operation."

5.4 Turbines 1A/2A, 3A/4A and Heat Exchanger HX3A

> **Note:**
> **This section is normally completed only when the refrigerator is shut down due to heat transfer between HX3 heat exchangers.**

_____ 5.4.1 Date_____.

_____ 5.4.2 Ensure that mechanical brakes are installed on turbines per C-A OPM 7.1.26, "Expander Brake system Installation and Removal."

_____ 5.4.3 Ensure the following valves are closed:

Process:

H328A____	H426M____
H346M____	H360M____
H376M____	H380A____

Others:

H407M____	H6180M____
H703M____	H9175M____
H9171M____	H427M____
H373M____	H778M____
H6179M____	

_____ 5.4.4 Start the regeneration (regen) skid per C-A OPM 7.1.36, "Regeneration System Normal Operation."

_____ 5.4.5 Ensure that the regulator PR9169M has been replaced with the spool piece.

_____ 5.4.6 To avoid spinning turbines, ensure pressure in HX3A is approximately equal to pressure in expanders (within 0.5 atm).

_____ 5.4.7 Open process valves H338M____ and H352A____ (air line must be jumpered at valve).

_____ 5.4.8 Open the following valves:

H405M____	H330A____ (Vanes)
H266M____	H339A____ (Vanes)
H6169M____	H354A____ (Vanes)
H378M____	H357A____ (Vanes)
H415M____	

_____ 5.4.9 Close regen manifold bypass valve H9100M.

_____ 5.4.10 If turbine train is cold, turn on regen skid pre-heater.

_____ 5.4.11 Monitor turbine 4A outlet temperature at TI361H.

_____ 5.4.12 When TI361H reaches 290^{o}K, continue to regenerate for at least one hour. Hygrometer reading must be –20^{o}C to –40^{o}C and improving less than 0.5^{o}C/hour.

_____ 5.4.13 Turn off regen skid pre-heater.

_____ 5.4.14 Open bypass valve H9100M.

_____ 5.4.15 Close the following valves:

H357A____ (Vane)	H378M____
H354A____ (Vane)	H6169M____
H339A____ (Vane)	H266M____
H330A____ (Vane)	H405M____
H415M____	

_____ 5.4.16 Install regulator PR9169M.

_____ 5.4.17 Purge expanders 1A/2A, 3A/4A and heat exchanger HX3A per C-A OPM 7.1.27, "Warm Expander Purge Procedure."

_____ 5.4.18 Close the following process valves:

H352A____ (Return air line to normal)
H338M____

_____ 5.4.19 Secure regen skid per C-A OPM 7.1.36, "Regeneration System Normal Operation."

6. Documentation

6.1 The check-off lines are for place keeping only. The procedure is not to be initialed or signed, it is not a record.

6.2 The Shift Supervisor shall document the completion of the procedure in the Cryogenics Control Room Log.

7. References

7.1 C-A OPM 7.1.26, “Expander Brake System Installation and Removal”

7.2 C-A OPM 7.1.36, “Regeneration System Normal Operation”

7.3 C-A OPM 7.1.27, “Warm Expander Purge Procedure”

8. Attachments

None